Digitized by the Internet Archive
in 2018 with funding from
University of Toronto

https://archive.org/details/medjournalNov1934uoft

THE UNIVERSITY OF TORONTO MEDICAL JOURNAL

(An Undergraduate Publication)

This journal is published seven times a year, November to May, by the Medical Society of the University of Toronto, to serve as a medium for student expression and to bring to the student recent articles of scientific interest.

STAFF ADVISOR
Prof. E. A. Linell, B.M., Ch.B., M.D. Manc.

EDITOR-IN-CHIEF
Paul Hamilton, B.A., '35.

ASSISTANT EDITOR
Omond M. Solandt, M.A., '36.

ASSOCIATE EDITORS
Miss E. M. S. Cunningham, '35.
Hugh Hayward, B.A., '37.
A. L. Chute, M.A., '35.

EDITORIAL REPRESENTATIVE
W. G. Bigelow, IV B. & M.

BUSINESS MANAGER
H. J. Bright, '36.

ASSISTANT BUSINESS MANAGER
A. Sturgeon, '37.

Address all communications to Room 107, Anatomy Building.

Volume XII TORONTO, NOVEMBER, 1934 Number 1

EDITORIAL

To outline the policy of the Medical Journal is a task which beggars all description. Within its covers it is attempted to interest a great many individuals whose knowledge and interests, as divergent as the poles, are separated by wide gulfs of learning. For those just entering Medicine, standing on the foothills of Medical Science, deep and wide chasms of learning must be traversed in order to reach the loftier peaks of the recent graduate, who in turn stands in awe of the sublime heights of his predecessors. Each rests upon his own pinnacle, each a little higher than his fellow. Each appreciates the plight of those that follow (but alas does not always sympathize). The problems of the first year have dwindled to nothing by the sixth year, their place being taken by other and more serious ones, and these in turn lose their significance as the years roll on. To appeal to such diversified interests is a task which is difficult to accomplish, mayhap impossible of accomplishment by the very nature of the undertaking.

And so it is with some trepidation we take up the editorial pen and shoulder the responsibility of producing Volume XII of the Medical Journal, and in that volume try to give each student that which is of interest to him without sacrificing the interests of his fellow students.

And so it is with these humble thoughts that the new editorial board take up its position for the coming year.

That our Journal is not mere child's play is evinced by the fact that in the past some of our articles have been catalogued in Index Medicus. Our thanks here is due to the invaluable assistance which we have always had from the members of the Faculty, and it is to be hoped that they will continue to give us the benefit of their experience. We appreciate their assistance but let us show our appreciation by not making them carry the burden of the Journal on their shoulders. It is your publication and as such, we, who are responsible for its maintenance, urge you to support both as subscribers and contributors.

* * *

And a word about contributions should not be out of place here. It is not the subject matter of the articles that is so important, be it Anatomy, Physiology, Clinical Medicine, Surgery or Pathology, but the fact that it is a contribution which is an expression of your own activity, your own patience in searching out information and in revealing to your fellow students those difficulties which you have encountered, and the manner by which you have solved them. For be a man ever so active, who can judge him if he does not make his activity speak where all may hear, and it is he who is well judged who has made his presence felt by written words. Need we say more? Suffice it to say that the editors are only too pleased and too willing to receive the humblest contributions, for the betterment of the Journal.

* * *

It is the custom in these pages to welcome the new year, just entering Medicine, and to extend to them our felicitations and receive them, not as little school-boys but as men, as embryo doctors who will in future time give the lie to our impossibilities and show strength where we show weakness.

You are coming to a university and a Faculty of Medicine which is not excelled anywhere. Remember that, but do not brag about it. That is cheap and sordid. But aim to benefit and be benefited by our good name.

Remember this too: Our teachers are men of high repute and unimpeachable integrity. Too often, far too often, does the phrase "plucked because of grudge" pass the lips of him who was at fault. Such things don't happen; can't, for who is there that would interfere with young brains, pregnant with unripe thoughts of greatness and bring about a miscarriage of ideas? Let that stupid, childish, school-boy attitude of one's professor being one's natural enemy, go into the dust-bin of half-baked notions.

But enough—Welcome, men of 4T0, and may your stay here justify your own ideals in us, and ours in you.

ABDOMINAL PAIN

By W. S. ANDERSON, B.Sc., M.D.

Historical.

Pain is the commonest symptom of disease; there is no symptom more informative to the practitioner and none at times more misleading, especially is this true of abdominal pain. But it was not until the fact became known that a loop of bowel brought out through the abdominal wall was insensitive to cutting, pinching or burning that men became thoroughly alive to the problem of explaining the pain in abdominal disease. Since then numerous observations have accumulated, some agreeing, some contradictory, and many deductions have been made, some logical, others quite inadmissable. But although pain is perhaps the most important evidence on which we base our interpretation and diagnosis of the acute abdomen, no view yet advanced of the structure and function of the afferent nervous system adequately explains our ever increasing collections of confusing clinical facts. It is my aim to review some of these theories paying particular attention to the principles involved and referring to particular disease only for the purpose of illustration, as the subject of abdominal pain clearly covers so much ground it is impossible either to consider every aspect or to enter into any great detail.

Almost the first to contribute to our knowledge was John Ross of Manchester who in 1887 distinguished two types of pain in visceral disease—a true splanchnic pain felt in the affected organ, and an associated somatic pain referred to the cerebro-spinal nerves of the body wall.

He claimed that the painful impulses passed up the splanchnic nerves to those segments of the spinal cord which supplied the diseased viscus and produced an "Irritable focus" or a state of irritation in the corresponding portion of the posterior horns of grey matter. Thus the threshold of stimulation for the posterior horn cells was lowered and the normally silent stream of impulses that are continually coming from the periphery were then capable of producing pain. However, Ross believed that the viscera were sensitive to the ordinary painful stimuli and when this was proved to be untrue his views lost ground, but they have influenced many writers ever since and his irritable focus is still found in text books and offers even yet the most attractive explanation for the radiation of pain.

Lennander, however, definitely established the insensibility of the exposed viscera to tearing, cutting or pinching (the ordinary painful stimuli) by operating under local anaesthesia. And from his observation he believed that all painful sensations arising in the abdomen were the result of stimulation of the cerbro-spinal nerves in the parietal peritoneum. He thought that not only the viscera but also the mesenteries, and great and lesser omenta were supplied only by the sympathetic nervous system which contained no afferent pain fibres.

The late Sir James Mackenzie, whose teachings were accepted for so many years, took an entirely different stand. He agreed with Ross as to somatic pain but rejected splanchnic pain as non-existent. He claimed that all pain due to abdominal disease was referred to the parietes by a viscero-sensory reflex, that is to say, when there is a morbid process in a viscus the normal stream of impulses that pass up the afferent nerves to the spinal cord and give rise to no appreciable sensation, are increased, and affect the neighboring centres stimulating sensory, motor and other nerves that issue from this part of the cord.

Stimulation of a sensory nerve results in pain referred to the peripheral distribution of that nerve, while if a motor centre is stimulated contraction of a skeletal muscle results, this latter being called a viscero-muscular reflex. He realized, however, how sensitive the parietal peritoneum appeared to be, but he attributed this to the somatic nerves supplying the subserous tissues and stated that it was not until an inflammatory process had spread through the parietal peritoneum that the cerebro-spinal nerves were stimulated giving rise to true somatic pain.

Hearst a few years later restored our belief in visceral or splanchnic pain by proving that an adequate stimulus, namely increased tension on the nerve endings in the muscular wall of such viscera as the oesaphagus, stomach, and colon produced a dull, griping poorly localized pain, and concluding, that pain was produced when the sympathic nerves in the smooth muscle of the stomach, intestines, bile ducts, and ureters received this adequate stimulus.

Some observers following a lead suggested by Head in his treatise on epicritic and protopathic sensations, and showing that the lower colon, rectal, gastric and oesophageal muscosa recognized temperature below 10° C as cold and above 50° C as hot, and that active or reverse peristalsis caused a distinct sensation even when the stimulus was not strong enough to cause pain, claimed that the pain was actually felt in the viscus itself and that the mechanism was similar to that occurring when the surface of the body was stimulated, the only differences being, that a different stimulus was necessary, and the impulses travelled in splanchnic instead of somatic nerves. They argued that the initial colicky pain of acute appendicitis was due to reflex stimulation of the stomach and intestines to violent peristalsis, and other discrepancies in their theory were explained in a similar manner.

Ryle was of the opinion that all abdominal pain originated from stimulation of the nerves in the muscular coats of the viscera whether it be referred or felt in the viscus itself. While Tyrell-Gray after showing that the mesentery was sensitive to mechanical, chemical and thermal stimuli advanced the view that true visceral pain primarily arose from the mesentery, partly by impulses from the pacinian corpuscles. He claimed that the pacinian bodies when stimulated by the mechanical tension of the body assuming an upright position excited a reflex muscular contraction of the abdominal wall protecting the mesentery from further stretching and argued that when a morbid process involved the mesenteries it stimulated these pacinian corpuscles which initiated the reflex muscular rigidity found in peritonitis.

Many others advanced their opinions but none were so widely accepted or exerted such a profound influence as that of Mackenzie. However, the clincian and the operator were continually being confronted with facts, which they could not reconcile with his teachings as, for example, Kappis, in operating under local anaesthesia repeatedly demonstrated that the parietal peritoneum, mesenteries, the gastro-hepatic omentum and the transverse mesocolon were acutely sensitive to pinching and tearing.

Another of this group of observers and investigators was John Morley who, in recent years, convinced of the inadequacy of the then accepted theory, established and in many ways revised the known facts regarding abdominal sensitivity. But before going on to discuss his alternative and simpler theory it would seem advisable to review a few anatomical facts which may aid us in our interpretation of abdominal pain.

Anatomy.

A description of the nerve supply of the viscera and their peritoneal coverings with a discussion of its motor, secretory, inhibitory and sensory functions, is obviously beyond

the scope of this paper. But I would like to call attention to the fact that cerebro-spinal nerves have never been demonstrated in any viscus, with a few possible exceptions such as the trigone of the bladder and that the viscera are entirely supplied by the Autonomic Nervous System. However, this very complicated and unravelled system of ganglia and connecting nerve fibres is so intimately linked up with the C.N.S. by the grey and white rami communicates, that, to consider each as functioning separately would surely be fallacious. The white rami through which it has been shown the afferent pain fibres pass to the posterior root ganglia and thence to the spinal cord, contain large and fine, myelinated and non-myelinated nerve fibres but which of these are the pain fibres and what their central connections are, is not definitely known. Ranson suggests they might be non-medullated fibres which run from the viscus uninterrupted to the small bipolar cells in the dorsal root ganglia, whose central axones run up the cord in Lissauer's fasiculi and finally end in the thalamus. Thus there is probably a direct pathway for painful impulses arising in the viscera to reach the brain where as we shall see these impulses are interpreted as a deep, griping, poorly localized pain.

The mesentery of the small intestine, the transverse mesocolon, the lesser omentum and probably the pelvic mesocolon are, on the other hand, supplied not only by the autonomic nervous system but also by somatic or cerebro-spinal nerves. Donald Sheehan definitely proved this anatomically in a series of experiments very carefully and laboriously carried out. He first of all compared the nervous system in the abdomen of several human foetuses near term with that of cats, and then carried out his investigations on a large series of these animals. He was able to show that there are three types of afferent nerve endings in the mesentery: first, Pacinian bodies in which end myelinated nerve fibres from the splanchnics and occasionally an odd twig of a fine non-myelinated nerve; second, free nerve endings of myelinated nerves; and third, free nerve endings of a fine plexus of non-medullated fibres which are purely sympathetic and have the same function as Auerbach's and Meissner's nerve plexuses with which they are connected, namely, the control of smooth muscle and probably the transmission of the impulses which give rise to visceral pain. The free nerve endings of the myelinated nerves are few in number but since they remain unchanged after the vagi, splanchnic and lumbar sympathetic have been removed, they must be of somatic origin, that is to say, they pass up to the cord via somatic nerves, although the actual fibres were never demonstrated. Their scarcity and variability he points out would explain the differences of opinion as to the degree of sensitivity of the mesenteries.

I would like to state here a point of interest while we are on the topic of nerve endings and what impulses different types of nerve fibres carry, that although there are many theories of specific function of different types of nerve endings, Waterston has shown that there is no structural punctate arrangement of special receptors and that for thermal sensation at least there are no special, specific nerve fibres.

The anterior parietal peritoneum and its subserous layer are richly supplied by the deeper branches of the somatic nerves which supply the more superficial structures over it (Ramstrom) while the lateral and posterior parts contain only a moderate number of somatic nerve endings, thus one can surmise, that the localizing power of the peritoneum on the posterior abdominal wall would be far poorer than that lining the anterior wall and this has been found to be the case. There has been no convincing evidence advanced that the abdominal parietes are supplied with sympathetic fibres that are capable of carrying painful im-

pulses, hence any impulses producing pain, that arise from stimulation of the parietal peritoneum must travel along somatic nerves.

An interesting point arises as a result of some of these observations. Since somatic nerves supply the mesenteries to within one inch or so of the gut, it is believed that the junction of the somatopleure and splanchno pleure is just a short distance from the gut and not at the root of the mesentery as embryology formerly taught us. Although this is rather extraneous, it helps us to remember which parts are sensitive to the ordinary painful stimuli and when stimulated give rise to true somatic pain.

Referred Pain.

Shoulder Pain—With these facts in mind let us investigate the pain referred to the shoulder when the under surface of the diaphram is stimulated, and see how Morley explains the mechanism involved and what conclusions he draws. Irritating fluids such as escaped gastric or intestinal contents, free blood, or pus, etc., or even the roughened surface of an organ as in perisplenitis and perihepatitis when they impinge on the exquisitely sensitive parietal peritoneum lining the under surface of the dome of the diaphragm, cause pain which is felt in the corresponding shoulder, in the area supplied by the supraclavicular nerves, and no pain is felt at the point of stimulation. Now the phrenic nerve arises from the 3rd, 4th and 5th cervical segments which also supply the skin over the shoulder and these segments have no splanchnic connections whatever with the abdomen. Hence, the mechanism of referring the pain, from the point of stimulation in the abdomen to the shoulder, must occur entirely in the C.N.S. and is therefore, according to Morley, a good example of true referred pain. Since subcutaneous infiltration (Morley) of the painful area with novocain, modifies or abolishes this pain, one would be led to believe that this pain is referred by some mechanism simulating Ross's 'Irritable focus,' but whether this occurs in the posterior root ganglia or in the C.N.S. cannot yet be stated.

From this, we learn that stimulation of the phrenic nerve endings in the parietal peritoneum covering the diaphragm (with the exception of the peripherial inch or so) produces a true somatic pain in the area supplied by what we may call its superficial branches, although, in development of the embryo they have become widely separated and Morley argues that since this is true here, why is it not true for the rest of the parietal peritoneum, which has a nerve supply which is essentially the same. Thus by a mechanism of peritoneo-cutaneous radiation painful impulses, arising in the deeper nerves affect their more superficial branches, producing (1) a well localized pain referred to the area over the point stimulated, and no pain in the peritoneum itself, (2) a tenderness of the more superficial structures to a firm palpation which is not sufficient to cause pressure on the structures deep to the rigid muscles and (3) an involuntary reflex rigidity of the overlying muscles, this latter mechanism occurs in practically the same way, the only difference being that the impulses must affect the anterior horn cells establishing a reflex—the peritoneo-muscular reflex. This theory of Morley's explains why, in acute appendicitis, the localized pain and the rigidity vary with the position of the appendix and are always directly over it or, in other words, it accounts for the great accuracy with which pain is referred to the structures directly over the place where the peritoneum is irritated. As Capps and Coleman showed, by piercing the abdominal wall with a trocar and stimulating the parietal peritoneum with a silver wire. The fact that when an inflamed appendix is lying in the pelvis there is very little tenderness and rigidity of the lower abdomen, but a marked tenderness at

the site of the organ on rectal examination would lead one to believe that the appendix itself, or the parietal peritoneum was tender, but when the diseased appendix is in its usual position, the pressure required to elicit tenderness is so slight that it is impossible for one to believe that they are pressing on the parietal peritoneum through the board-like muscles. It may also be added that although the tender area might be quite large, depending on the strength of the stimulus and probably the condition of the nervous system, there is always one point of maximum tenderness. Occasionally an area of hyperalgesia is created; but since it is so variable and indefinite, and is also found in neurotic patients with no pathological process, it is of little aid in diagnosis and hence only of academic interest.

Mackenzie recognized that these mechanisms did occur, but he claimed that they could not be differentiated from similar phenomena resulting as he thought from stimulation of nerves in the viscus itself, and acting through viscero motor and viscero sensory reflexes. But any pain and tenderness arising from irritation of nerves in a viscus would always be referred to the same area, no matter what position the viscus was in, as movement of the organ would not alter its connections with the C.N.S. This difficulty does not arise in accepting Morley's explanation as he claims that painful impulses, arising from inadequate stimulation of the nerves in the viscera, are carried directly to the brain without any reflex mechanism being involved, and are interpreted there as pain.

Abdominal Pain — An example of this true visceral pain is seen in the initial pain of a typical attack of acute appendicitis. It is felt in the mid line just above or at the umbilicus, or in a vague area around that region, and is a griping, intermittent, colicky and very poorly localized pain which is not associated with any tenderness or true rigidity. It originates in the appendix itself, and is the result of the frantic spasmodic efforts on the part of the muscle to force the irritating contents in its lumen past an obstruction at its base. This stretches the splanchnic nerve endings in the smooth muscle, producing painful impulses. Evidence of such an obstruction is found in all appendices removed at operation from patients who suffered from what we may call appendicular colic, in the early stages of their disease. When the pain shifts down to the right iliac fossa the parietal peritoneum has become involved either by a spread of the inflammation through the wall of the appendix to its serous coat or by rupture. If the latter occurs the initial pain disappears as the tension is, of course, relieved.

In all acute abdominal diseases the resulting pain is either splanchnic or somatic and as we have seen two distinct mechanisms are involved. If both types of pain are present they can usually be differentiated readily, as their characteristics are so distinctive. Visceral pain is vaguely localized, dull, intermittent, colicky, causing the patient to double up and writhe around in bed; while somatic pain is well localized, sharp and stabbing, accentuated by any movement on the part of the patient, and is often associated with tenderness and rigidity of the muscles. Thus in the biliary system if the gall bladder or ducts are thrown into spasm by a stone or an inflammatory process, severe splanchnic pain results which is referred to the mid line in the epigastrium, as these structures are outgrowths from the junction of the primitive fore gut and mid gut, and the brain can only interpret the painful impulses as coming from around that area. Now if the parietal peritoneum becomes involved, by inflammation spreading through the walls of the ducts or the gall bladder, true somatic pain results. If the anterior parietal peritoneum is irritated the pain is well localized over the point of stimulation; but if it is the posterior parietal peritoneum that receives the painful stimulus, although

purely somatic in character, it lacks the quality of being definitely localized and is referred to an area at the inferior angle of the scapula. Occasionally shoulder tip pain is felt. Morley believes that in about five percent of people, the region of the bile ducts is supplied by the right phrenic nerve and that when the disease process spreads from the duct to involve this region, somatic pain is referred to the shoulder along the phrenic nerve.

The pain of intestinal obstruction is also easily explained. The somatic nerves of the parietal peritoneum are not affected, but only those nerves in the wall of the gut proximal to the obstruction receive an adequate painful stimulus, as they are stretched by the exaggerated peristalsis. Hence the pain is entirely visceral in type and is felt either above or below the umbilicus depending on whether the small intestine and colon up to the hepatic flexure or the rest of the colon is involved. From performing laparotomies under local anaesthesia it has been found that the liver and spleen are insensitive to manipulation and pinching, etc., as we would expect, since they have only a sympathetic nerve supply, but we all know how tender the liver apparently is, in the passive congestion of right heart failure. No change can be demonstrated in its peritoneal covering that would allow us to believe it could irritate the parietal peritoneum over it and thus reconcile this tenderness with the Peritoneo-cutaneous Radiation theory. However, Morley believes that, since the parietal peritoneum is sensitive to such weak stimuli as a moist sponge, sterile blood, and the seemingly normal tissue over the base of a peptic ulcer, that certain chemical substances which we can't demonstrate, are sufficient to provide an adequate painful stimulus. When the muscle tires or is poisoned by the resulting toxaemia, the gut balloons out and the adequate stimulus seems to be lacking as the pain disappears, to be replaced by distension and a distressing sense of fulness. However, if the bowel becomes gangrenous it irritates the parietal peritoneum, producing localized pain and tenderness. It must be remembered that some investigators claim that the pain results not from stimulation of the nerves in the wall of the gut but from stretching of the nerves in the mesentery which is put under tension when the curved gut contracts and tends to straighten out, but this question has not yet been settled.

Genito-Urinary Pain—Pain arising from disease of the genito-urinary system brings up many puzzling problems. Morley believes that since the pelvis of the kidney is sensitive to some of the ordinary painful stimuli such as the pressure of an ureteral catheter, there must be somatic nerves supplying the pelvic mucosa., although these have never been demonstrated. It is true that if the kidney and ureter were supplied by cerebro-spinal nerves it would help us materially in explaining (1) this sensitivity of the pelvic and ureteral mucosa to mechanical stimuli (2) the peculiar testicular sensation that is experienced on squeezing the kidney (3) the continuous pain thus differing from renal colic, felt anteriorly and in the costo-vertebral angle when there is a stone in the pelvis (4) the reflex contraction of the cremaster muscle drawing up the testis on the same side during an attack of renal colic. (5) Pain referred to the tip of the penis when the trigone of the bladder is stimulated mechanically and many other phenomena met with clinically. However, until more evidence is forthcoming we must be content with the knowledge that such pains do occur in these diseased processes and accept the obvious explanation for some of the less confusing facts.

The testis also gives us difficulty. It receives its nerve supply from 1 and 2 lumbar segments and it is sensitive to pressure which causes pain, felt first in the testis itself, then, as the pressure is increased, in the area of the internal abdominal ring (L1), and finally to the tenth dorsal segment level. Woolard and his co-workers made use of these facts in trying to refute Morley's

claim that afferent splanchnic fibres never form the afferent limb of a reflex arc which results in referred pain. They found, by blocking all possible nerve pathways from the testis with novacaine, except those around the spermatic artery which are splanchnic in origin, that pressure on the testis caused definite pain, which was referred to the tenth dorsal segment level and localized to the side stimulated. This they are certain, is indisputable evidence that pain may be referred through the sympathetic nerves to a somatic nerve area. These same investigators also found that in operating for avulsion of the phrenic nerve under local anaesthesia, squeezing the proximal end of the cut nerve produced pain localized to an area the size of a quarter just internal to the acromio clavicular joint and that infiltration of this and the surrounding area with novacaine had no effect at all on the pain. I cite these experiments to show how much controversy there is on the subject and how far we are from knowing the exact mechanism of abdominal pain.

Peptic Ulcer Pain — Peptic ulcers also raise another point for debate. Morley's theory satisfactorily explains the point of tenderness to deep pressure that always corresponds with the exact position of the ulcer, in that the parietal peritoneum pressed down on the visceral peritoneum over the ulcer, receives a stimulus of some kind sufficient to cause pain referred to the superficial structures. It also gives a reason for the continuous somatic pain in the back from an ulcer that has penetrated the posterior wall of the stomach and is involving the peritoneum, for the pain, rigidity and shock in acute perforation. But there have been as many theories advanced to explain the periodic so called hunger pain of peptic ulcer as there have been suggestions as to cause of the ulcer itself, and none are any more convincing or satisfactory. It is true that some workers have produced pain at will by introducing dilute hydrochloric acid into the stomach and brought relief by neutralizing it, but others in similar investigations have reported inconsistent and contradictory results. So, to account for this and the periods of remissions when patients are entirely free from pain, and those cases of pain with achlorhydria, we must look for some other factor. Since the X-ray has come into common use, it has been shown that pain may be present with the stomach in all stages of contraction, from complete atony to violent spasm, so tension on the nerves in the muscle wall cannot be the only pain producing mechanism. Kinsella advanced a very ingenious theory that cellular infiltration, increased volume of tissue fluids and vascular congestion in the ulcer area causes compression of the nerve fibres and thus produces continuous visceral pain and although he tries to reconcile it with all the clinical features of ulcer pain his arguments are not very convincing; and it would seem that some factor must yet be accounted for. Whether we will have to turn to something pathologic in the nervous system itself such as an increased irritability or sensitivity, abnormal tonic impulses, or summation of stimuli remains to be seen; but it is evident a more precise knowledge is necessary before we can say what the true stimulus really is.

I have purposely not mentioned the pain in chronic disorders or the so-called chronic abdomen as there are so many other factors (psychogenesis, temperament, habit pains, neuroses and the like) to be considered, that it is a topic in itself. Nor have I dwelt on the differential diagnosis of the various abdominal diseases from the types of pain in each; but instead I have tried to present some of the principles that are involved in the mechanism of pain production and to give a few of the arguments for and against one of the prevalent theories which explains many facts in a very cogent manner.

VOMITING IN INFANTS AND OLDER CHILDREN

By W. B. PARSONS, M.D.
Toronto General Hospital.

The paediatrician in dealing with infants particularly but also with older children has not at his command a factor in arriving at a diagnosis which the physician finds so valuable, namely an accurate subjective history; he relies mainly on objective symptoms, physical signs and laboratory examination. Thus it is that in paediatrics a thorough knowledge of the more common objective symptoms such as vomiting and diarrhoea is essential to successful practice. It is my intention in this paper to review the more common causes of vomiting in infants and older children and to suggest a few principles in treatment.

Vomiting is a highly co-ordinated act which is set up by stimulation of the vomiting centre which lies in the medulla near the respiratory centre. This stimulation may result from irritation of the centre itself by either toxic or mechanical factors, in which case the vomiting is central; the other type is peripheral or local and is initiated by irritation of the pharynx or gastric mucosa especially, although powerful stimulation of any part of the body may cause vomiting.

Two types of vomiting are noted in infants.

A. Regurgitation or vomiting without discomfort. Here the food is brought up easily and without apparent effort. It may be ejected, without force, or may be retained in the mouth and placidly chewed for some time before swallowing; this condition is known as rumination.

B. Vomiting with discomfort which includes the ejection of small amounts of food from the mouth as a result of forceful eructation of gas. A more severe form of this type is projectile vomiting in which the vomitus is ejected with considerable force sometimes several feet.

In infants the origin of the vomiting is most frequently peripheral; the infant so recently having been transplanted to a new environment is a sensitive individual and takes some time to accommodate himself to his new surroundings so that stimuli which later will have no effect or cause only moderate discomfort will at this stage often prove very irritating and the irritation most often manifests itself in vomiting.

For purposes of classification vomiting is divided according to causation and three classes are described: Mechanical, Nervous and Toxic.

I. Mechanical

A. Due to errors in feeding.

i. Overdistension of the stomach by overfeeding and air-swallowing.
ii. Too rapid distension of the stomach by too rapid feeding.
iii. Improper feeding mixtures which form curds and thus cause retention.
iv. Hunger and underfeeding.
v. Tight binders.
vi. Agitation of the child after feeding.

B. Due to organic disease causing mechanical obstruction.

vii. Pyloric stenosis.
viii. Intussusception.
ix. Obstruction due to mesentric bands, pockets and herniae.

II. Nervous

A. Functional.

x. Pylorospasm.
xi. Reflex due to irritation in various parts.
xii. Habit.
xiii. Migraine.
xiv. Neurotic.

B. Organic, due to organic disease in C.N.S.
- xv. Meningitis.
- xvi. Brain tumour and abscess.
- xvii. Haemorrhage and trauma.

III. Toxic.

A. Due to infection — whether enteral or parenteral.
- xviii. Enteral — typhoid, paratyphoid, dysentery, appendicitis, intestinal intoxication, etc.
- xix. Parenteral — any acute infection.

B. xx. Due to ingested poisons including food allergy.

C. xxi. Due to retained catabolic products as in uraemia and possibly in Cyclic Vomiting.

Feeding Causes.

The majority of cases of vomiting in infants are associated with feeding and result from the following causes:

Overdistension—One common cause of this is overfeeding, the infant being fed too often or too much at one time. The condition is seen chiefly in breast fed infants who are up to normal weight but are nervous and irritable and are troubled with frequent attacks of intestinal colic due to fermentation and distension in the intestine, these attacks are characterized by screaming, a lividness of the face and body, a coldness and clamminess of the extremities and a drawing up and kicking out of the legs. The child nurses vigorously for the food relieves the pain but very soon after feeding some of the milk is spat up unchanged or there may be curds brought up, a residue of earlier feedings.

This child has 5-7 loose green stools a day with a lot of mucus and gas and curds of fat may be present where too frequent breast-feeding has resulted in the child getting an excess of fat; these stools are quite acid and frequently cause an excoriation of the buttocks.

Treatment — In the treatment of vomiting as in that of every other symptom, the object is to eradicate the cause.

In the case of overfeeding, the child should be allowed to nurse for only five minutes at a time or should be given one ounce of barley water or protein milk just before feeding.

If too frequent feeding is the cause of the vomiting, establishment of regular feedings four hours apart will clear up the condition.

Swallowing of air will also cause overdistension of the stomach. In breast fed babies this occurs where there are small inverted nipples or where the supply of milk is poor; in bottle-fed babies it is usually due to too small a hole in the nipple. Between feedings air is often swallowed when the child is allowed to suck its fingers or a pacifier. The vomiting is not usually severe, only a small part of the meal being brought up.

The best treatment consists of lifting the baby to the shoulder three or four times during the feeding and patting its back so that the gas in the stomach is expelled but the food remains.

Irritation of the stomach can also result from other factors than overdistension, of which the most important are:

Too rapid feeding causing too sudden distension is seen most frequently in bottle-fed babies; the infant vomits immediately after nearly every feeding, the vomitus and stools are normal, the cause is found in too big a perforation in the nipple which allows the child to finish his feeding in five minutes or less instead of the usual fifteen.

The treatment is obvious.

Improper Feeding — An excess of fat in the feeding mixture results in some of the fat not being digested and forming curds which will not readily pass the pylorus so that retention results. The infant loses its appetite and becomes restless and irritable; vomiting occurs at various intervals. Often the meal and the vomitus shows curds.

The stools may be loose, slimy and green and may contain curds of undigested fat and may be very iritating to the skin.

Treatment of the condition consists

of decreasing the percentage of fat in the feeding formula.

Hunger and **underfeeding** are further causes of vomiting and mistakes are often made in thinking the vomiting due to overfeeding and reducing the diet when the contrary procedure should be carried out.

The child is smaller than normal and has not gained as it should; it is restless and irritable and does not sleep continuously between feedings as does the normal child; at feedings it may refuse to nurse or may nurse vigorously for a few moments and then give up and start to suck its fingers or cry, at which time it is likely to vomit. The bowels are usually quite constipated and stools may be only 4 or 5 in number and quite small.

Treatment consists of increasing the fat.

Other causes of vomiting associated with feeding are **tight binders** and **agitation** after feeding; the infant should not be handled after feeding but should be put at rest for at least one half hour.

Organic Causes.

Such are the causes of vomiting due to errors in feeding and they are usually easily remedied. But vomiting may be an indication of serious underlying organic disease. Among these is pyloric stenosis which so closely resembles pylorospasm that they will be considered together.

Congenital pyloric stenosis is a condition in which the circular muscle fibres in the pyloric sphincter are greatly hypertrophied causing a blockage of the pyloric orifice. This condition occurs with equal frequency in bottle-fed and breast-fed infants. The symptoms usually come on in the first few days of life, rarely later than one month after birth. The principal symptom is vomiting and this is generally very severe and projectile in type; it usually occurs after each feeding, but in the later stages may occur only occasionally. The amount being greater than the amount of the feeding, indicating a dilation of the stomach.

Due to inanition the infant loses rapidly in weight and is very hungry but there are no signs of indigestion such as colic or diarrhoea; in fact, the stools are small and rare.

The diagnosis is made on these symptoms on the presence of a dilated stomach which ofter feeding shows visible peristalsis and on the presence of a mobile tumour about the size and shape of a small olive situated about half an inch to the right of the midline at a point half way between the umbilicus and the tip of the ensiform process.

Treatment—The only treatment is surgical and should be carried out as soon as possible after the diagnosis is made; the most popular operation is that of Webb-Ramstedt which consists of cutting through the hypertrophied sphincter down to the submucosa, leaving the mucosa intact.

Pre-operative and post-operative treatment is important; the former consisting of washing out the stomach thoroughly before operating, the giving of a transfusion and of interstitial saline and glucose solution; the latter in carefully regulated feeding. One half ounce of breast milk is given q. 4 h x 5 or 6 increasing the amount by 1 drachm each feeding until 2 ounces is reached; if vomiting occurs, feeding is stopped, if not, the amount can be quickly increased to the infant's caloric requirement.

Pylorospasm is a condition in which there is a nervous spasm of the pylorus but no organic stenosis. In pylorospasm the symptoms are similar to those in stenosis, but they are usually much less severe. The condition is most often seen in the nervous type of infant, the so-called hypertonic child who is wide awake and bright, very active muscularly, holding his head up very early and able to bear his own weight at 2 or 3 months of age.

The vomiting usually starts later than in cases of stenosis, generally a few weeks after birth but even up to 2

or 3 months it is not so severe. There is a marked loss of weight but the stools are larger than in stenosis. Dilation of the stomach and visible peristalsis are not so marked and if a tumour be felt it is likely to be thinner and longer than that in stenosis and may be felt to contract and relax under the examining finger. However, very severe cases of spasm do occur which cannot be differentiated from true stenosis.

Treatment—The treatment is medical and atropine is the drug which usually serves to remedy the condition. 1-1000 of a grain is given before each feeding and if this is not sufficient, the dose is increased until vomiting is controlled or signs of overdosage appear. Atropine will usually suffice but in some cases luminal is also given—1-10 grain before feeding. A thick feeding such as cereal and milk is more easily retained and may help control the vomiting. Washing out the stomach several times a day with a bicarbonate of soda solution helps some cases.

Intestinal obstruction is another serious source of vomiting and the most common cause of it is intussusception although mesenteric bands and pockets, Meckel's diverticulum and misplaced mesentery can also cause obstruction.

Intussusception consists of an invagination of one part of the bowel into another, usually an ileo-caecal invagination. The etiology is obscure although trauma, diarrhoea and congenital malformations and kinks are possible causes.

The onset is usually sudden, a previously healthy baby is seized with severe abdominal pain and vomiting. The stools consist at first of fecal matter, mucus and blood, red-currant jelly stool. The child is usually profoundly shocked, with moderately elevated temperature and in 85% of cases a sausage-shape tumour can be felt abdominally and per rectum.

In less severe and less acute cases some difficulty may be experienced in differentiating the case from one of infectious diarrhoea. However, the latter does not usually come on so suddenly, the temperature is usually higher and the abdomen is generally sunken while in intussusception it is distended.

The treatment of these conditions is immediate operation.

Vomiting of Nervous Origin.

This may be either functional, due to reflex irritation or due to organic disease in the nervous system.

Pylorospasm is a functional spasm of the pylorus causing retention and vomiting.

Reflex vomiting is seen in some infants at teething time and irritation of the pharynx whether by coughing or by the presence of mucus in the throat is another common cause.

Habit is a very great influence in vomiting and in many cases due to this habit factor vomiting may persist after the cause has been removed. This is very commonly seen in regurgitation and rumination and may be very difficult to handle. In mild cases giving a thicker food may help, this may be prepared by adding a cereal to 2% milk, cooling until thick and feeding with a tongue depressor. This thicker material is not regurgitated as easily as a fluid feeding. Water must be given between feedings.

In more severe cases diversion is necessary: toys may prove sufficient, but in some cases a constant attendant is required to divert the child when it appears to be about to vomit.

Central vomiting may be of such functional types or may be due to organic disease of the nervous system or to toxaemia.

The commonest **organic disease** is meningitis, although brain tumour and brain abscess may cause vomiting, as may also haemorrhages, these conditions are all more common in older children.

Toxic Causes.

Vomiting is common and almost invariable at the **onset of any acute infection** in infancy, whether enteral or parenteral; it usually occurs only once

or twice but may persist throughout the course of the illness due to an indigestion resulting from the infection.

Ingested poisons will cause vomiting both due to irritation of the gastro-intestinal tract and to irritation of the vomiting centre after absorption. Young children frequently get their hands on poisons carelessly left around and this cause must be considered.

Uraemia is another rare cause of toxic vomiting.

Food allergy also belongs in this group, and some cases are seen in which certain foods cannot be retained.

Acute intoxication is a disease entity causing vomiting in infants. This condition is almost never seen outside of the summer months, is very rare in breast-fed infants or the perfectly healthy bottle-fed baby and is believed to be due to an excess of carbohydrate in the diet causing an intoxication and giving a more suitable food for organisms to cause an intestinal infection. The greatest morbidity is seen at six months of age.

The symptoms are sudden in onset, the vomiting is severe and diarrhoea accompanies or sometimes precedes it. The temperature is high—from 103 to 105° F.—and convulsions are common.

The appearance of the child is typical; the eyes are staring and sunken, the mouth open and muscle twitching is noted; the child is very toxic and dehydrated and the liver is usually quite enlarged.

Treatment—Many of these cases follow a mild dyspepsia which is not treated or is improperly treated. Thus the best treatment is prophylactic—guarding against the causes of dyspepsia. Breast feeding is, of course, urged; overfeeding is to be guarded against. If artificial foods are used the milk must be boiled and special attention paid to the constituents of the feeding. Any dyspepsia or diarrhoea should receive prompt attention.

In cases where the disease is full blown the treatment varies with the severity of the case. If the child is moderately to severely ill, it must be transfused; continuous intravenous and interstitial saline and glucose is given per os as soon as it can be retained. This can be followed up with protein milk and similar feedings until a normal diet can be tolerated.

Older Children.

In older children anatomical factors play a much smaller part in the production of vomiting than in infants; parenteral infections, too, are much less likely to set up a dyspepsia with its accompanying vomiting.

However, attacks of vomiting are quite frequent and are so often due to some dietary indiscretion or other minor cause that the parents merely consider them as bilious attacks and administer a purge. However, too often these bilious attacks are of much greater significance and the attack of vomiting in a youngster always merits a careful study of the history and a physical examination.

Acute dyspepsia is by far the commonest cause of such attacks which are brought on by some dietetic error or overloading of a not very sound stomach, setting up a gastro-intestinal intoxication.

In this condition the onset is sudden although there may be a history of dyspepsia and low gastro-intestinal tolerance; the attack is usually ushered in with a headache, anorexia and malaise followed by nausea and vomiting; there is fever. the temperature usually being 101-102° F. and is often accompanied by marked prostration. The bowels are usually constipated but later on there may be diarrhoea.

On examination the tongue is furred and the breath usually foul and if the vomiting has been severe one may detect the odor of acetone. The abdomen is distended and the pulse usually rapid.

These cases often resemble typhoid or paratyphoid fever or an acute meningitis or a case of infection elsewhere in the body may give similar symptoms.

Treatment consists of emptying out the stomach and intestines; if the symptoms still persist it can be assumed that infection is present either in the gastro-intestinal tract or elsewhere.

Calomel 1-2 grains may be used as a purge; also castor oil or rhubarb; a glycerine enema is often effective, in some severe cases gastric lavage may be required.

Appendicitis is also another common cause of the so-called bilious attacks. The typical case of acute appendicitis will not likely be missed but there are many milder cases which are often passed lightly over. The child, usually of school age, though often younger, has attacks of moderate vomiting with slight epigastric pain and constipation. Examination will reveal a certain amount of rigidity on the right side with moderate tenderness on deep pressure. These cases must be looked for and operation is indicated as, though many of them clear up, some will develop further and by the time they are ready for operation the child's life will be endangered.

Cyclic Vomiting is one condition peculiar to childhood which is frequently met with and is, as yet, of unknown origin.

This condition usually begins in early life, the majority in the first five years. It is most frequently seen in individuals of a nervous temperament who are irritable, and may have exhibited such symptoms as habit spasm and somnambulism.

The disease is characterized by vomiting of sudden onset with no apparent cause; in severe cases absolutely nothing can be held down. The child is often drowsy, may have headaches and frequently has epigastric pain. The bowels are costive and there may be a fever with the temperature up to 102 or more.

Although the onset is sudden in some cases, various prodromal symptoms such as headache, irritability, sallow complexion and lassitude are noted. The attacks vary in frequency from one a fortnight to one or two a year; they last from one to three days, stop suddenly and the child is normal again in a few days, depending on the severity of the attack.

Treatment—It has been found that alkalis are almost specific for this condition, there is a pronounced tendency to acidosis and the alkalis correct this. Sodium bicarbonate grains 5 in 2 drachms of water is given every hour for six doses and then every 2 hours; if this cannot be retained, soda is given per rectum, 2 drachms in a pint of water. In severely dehydrated cases continuous intravenous of saline may be necessary with glucose 5%, if food has not been held for 24 hours. Food may also be administered as 10% glucose solution by mouth if tolerated, if not, nutrient enemata of peptonized milk may be given every 6 hours.

As a prophylactic measure sodium bicarbonate gr. 5 tid. may be given; the dose should be increased if an attack seems imminent and the child should be put on a high carbohydrate diet with no fat.

Parenteral infection must be watched for in vomiting children. In cases of meningitis, especially tuberculous, the symptoms are often predominantly gastro-intestinal with headache, nausea, vomiting, fever and possibly abdominal pain at first, and one may err badly in giving a good prognosis only to see later signs of meningitis developing.

Many cases of renal vomiting are considered gastro-intestinal in origin until some event occurs indicating the real source of the trouble; among such are cases of vomiting due to pyelitis, intermittent hydronephrosis and renal calculus. A good history with a thorough physical and laboratory examination will, in nearly all cases, lead to a correct diagnosis.

Vomiting Due to Nervous Causes.

Nervous factors are more active in the production of vomiting in children than in infants. Again they may be functional or organic.

Most common among the functional types is neurotic vomiting while migraine is occasionally seen.

Neurotic vomiting is a distressing condition and is seen most often among nervous, irritable and spoiled children. Often the cause is very obscure but a careful study will usually bring to light some evidence indicating that the vomiting is a defense mechanism used as a means to gain an end. Examples of such are seen in the child who vomits after breakfast because he does not like school, the child who uses this method of drawing attention to himself and those who vomit what they do not like but are forced to eat. Violent emotion will also cause vomiting.

Treatment of this type of vomiting is very difficult, the cause must be found and then an attempt made to remedy conditions or adapt the child to them. Gastric lavage in many cases has produced a miraculous cure and other stern measures may be tried.

Migraine

This condition is rare in childhood but when it does appear it is usually seen at from 5 to 12 years of age.

In children the condition is different from that in adults in that in the former it is accompanied by fever. The child is troubled with a headache, often unilateral and is found to have a fever; after a variable number of hours the child vomits, usually only once or twice, and then goes to sleep, waking up normal. Great difficulty may be experienced in differentiating this condition from one of cyclic vomiting or acute dyspepsia, and in fact several patients with cyclic vomiting in infancy have been noted to develop migraine in later life.

Treatment of this condition must first ensure good digestion and regular actions of the bowels. Overeating and gulping of improperly masticated foods must be guarded against and the bowels kept open with such laxatives as cascara and malt or milk of magnesia.

A sufficiency of fresh air in the classroom and home must be present.

If with this treatment attacks still occur phenazone can be given 2 or 3 times a day in a mixture of rhubarb and soda. During the attack phenazone or phenacetin with caffeine citrate is of value but in many cases relief is only obtained after vomiting and sleep.

Organic nervous conditions which may cause vomiting are meningitis, brain tumour and brain abscess. Meningitis has been mentioned and the latter two rarely cause vomiting in children but must be considered when no more obvious source is found.

Diagnosis.

From the above it will be seen that the causes of vomiting are many and varied. To determine the cause a careful history and physical examination is necessary. One must ascertain i. The amounts of vomitus. ii. Whether it is brought up all at once or regurgitated in small amounts. iii. The character of the vomiting, whether forcible or not. iv. The character of the vomitus, whether bile-stained, bloody or food. v. The relation to meals. v. The presence of nausea as determined by the appetite. vii. The presence of gastric peristalsis, and viii. The presence of any other evidence of disease, pain, fever, prostration, &c.

In an otherwise healthy infant, if pain is not severe but is mostly regurgitation, the cause is probably mechanical. Careful observation of the infant at and between meals will often reveal the cause. If vomiting is accompanied by loss of appetite, faulty feeding formula or parenteral infection is likely the cause; in this case the vomiting will not likely follow immediately after the ingestion of food.

Severe and projectile vomiting may occur at the onset of an acute infectious disease with neurological conditions or acute abdominal disease.

Bile in the vomitus does not occur in pyloric obstruction but is present in acute abdominal disease and in most cases when vomiting is seen.

With these factors in mind the cause of vomiting in infants and older children should be diagnosed without excessive difficulty.

CHINESE MEDICINE

By MARGARET R. QUENTIN, '39.

China's medicine like her civilization is very ancient. Because she has been relatively isolated up to recent times her influence on the history of modern medicine has been negligible. In the same way Chinese medicine has been influenced only to a small extent by other countries. China has lacked the continual international traffic, stimulus and refinement through new ideas which has been a great factor in the development of the Mesopotamian, Egyptian and Aryan civilizations, and of the European which was founded upon these.

China has revered her past from time immemorial. Primitive beliefs still persist in the practice of medicine. Procedures that probably had their origin 30 or 40 centuries ago are practised today by many Chinese physicians.[2] There has been no medical history in the same sense as in western medicine, with its record of a fairly continuous effort to establish a science of medicine upon anatomy and physiology. However, their medical literature is abundant and the theories which took the place of anatomy and physiology, and their modes of treatment are of great interest.

As in every early civilization, religion and astrology merged into healing, so in China, the medical profession was from the earliest times dominated by priests and sorcerers. They were separated about 1140 B.C. Dr. K. C. Wong[1] has divided the development of medicine in China into four periods. The first is the ancient or legendary period down to 1000 B.C. The second is the historical or classical period from 1000 B.C. to 1000 A.D. The third is the medieval or controversial period from 1000 A.D. to 1800 A.D. With the 19th century the fourth or modern period began when western medicine entered the country.

In the classical period some progress was made, but it is characterized by philosophical reflection rather than experimental study. As reverence for scholastic authority gradually petrified medicine into a very formal art it became heavily encumbered with excess detail. Two doctrines emerged which form the basis of Chinese medicine. These together with certain medical procedures will be discussed later.

In the medieval period many monographs appeared on particular diseases and encyclopedias were compiled. Besides the discovery of small pox inoculation in 1022 A.D. little new was added to the science. Medical schools and the holding of state medical examinations were established.[1]

Human dissection was seldom attempted because of the great reverence for the dead. From this factor gross mistakes arose concerning anatomy and physiology. A few investigations were carried out under the orders of an emperor, a governor and a celebrated man on bodies of captured revolutionaries, aboriginal peoples, executed rebels and famine victims. Maps were made of internal organs and bamboo rods were inserted into blood vessels to trace their course. The

anatomy of Chinese physicians is based on the above investigations and has not been changed for centuries.

Doctrines.

The first basic doctrine of ancient Chinese medicine is the doctrine of the two primary principles, the Yang and the Yin. Everything arises from these and is controlled by them. They represent in antithesis the male and female element, heaven and earth. heat and cold, life and death, sun and moon, strength and weakness, positive and negative, summer and winter, acid and alkaline, anabolic and catabolic changes and other contrasting forces.

The second doctrine concerns the five elements. These are fire, water, earth, wood and metal. They are produced by the interaction of the Yang and the Yin and each contains some of both principles. All things are combinations of these elements. The human body in health contains a harmonious proportion of them,—disease occurring when the balance is disturbed. Corresponding with the five elements are the five major organs, the spleen, liver, heart, lungs and kidneys, and there are further related in a complex scheme, to the five planets, the five colours, the five tastes, the five climates, etc.

Medical Practices.

Acupuncture is an old practice. It was practically a cure-all and was used commonly in the treatment of cholera, cough, colic, hernia, rheumatism and any localized pain or swelling. They describe 367 points on the body where puncture may be performed.

Moxilination is popular. Small cones or moxas of leaves or pith are burned on the skin. They are carefully placed and their function is to make a passage for the stagnant pathogenic materials or to draw them out.

Massage gained a very important place in Chinese medicine for a while, but later degenerated.

Narcotic drugs were used by a famous surgeon about 200 A.D. who was able to perform all sorts of operations ranging from venesection, to laparotomy, excision of the spleen and various operations on the intestines and liver.[1]

Four methods of diagnosis[1] were introduced in the classical period. They were observation, auscultation, interrogation and palpation. In the course of time the first three fell into disuse and entire reliance was placed on palpation. It came to be believed that any disease could be revealed by the pulse alone. There are many pulses described such as pulses resembling a fish caught by the head who waggles his tail quickly and irregularly, or a hollow pulse like an onion stalk, or the drifting character of wood floating on water, or slippery like a pebble rolling in a basin which indicates 3 months pregnancy. A conscientious Chinese practitioner frequently took more than an hour feeling his patient's pulses.[4]

Inoculation for small-pox was discovered in 1022 A.D. There were four methods of inoculation: (1) by taking the wet serum directly from pustules and inoculating by a needle, (2) by blowing the powdered scale into the nostril, (3) by inserting a wet scab into the nostril and (4) by wearing an infected garment. Cow fleas were also used to prevent small-pox. It was believed that the fleas of a cow suffering with vaccina might be used to immunize a human individual. This treatment is said to have become very popular.[3]

With regard to ophthalmology a few operative measures were used. Treatment of errors of refraction with corrective glasses has been practised for centuries.[5]

Obstetrics remained almost exclusively the province of the mid-wife. The active aid of the physician was rarely called for and only extended to the prescription of internal remedies.[5]

Among Chinese medical literature are extensive books on materia medica. Countless formulae and substances are enumerated. The Chinese were prob-

ably the first to use rhubarb, ginger and mercury, in the form of cinnabar, internally, attracted no doubt by its bright red colour. A celebrated remedy is menthol, which is effectual in cases of neuralgia and has spread throughout the civilized world.[4] The following medicines are recommended in the Chinese medical books and they give a general idea of what is used: "Medicines which increase the natural fire, stimulating tonics—cassia, cinnamon, stalactites, tips of the horns of deer, dried spotted lizard, silkworm moth. . . . Medicines which strengthen the kidneys and testes—glue from the stag horns, bones, stag and dog flesh, dried placenta, ferns, walnuts . . . repressing weakness are tonics—iron filings, haematite, talc, litharge, gold and silver leaf . . . Medicines which disperse wind—bivalve shells, cassia, menosa, seeds of acacia, bones, spotted and black snake, cicada, centipede, shed snake skins, camphor . . . Mild equalizing resolvent—chamomile, rush burdock seeds, duckweed, betel nut, quicksilver, chloride of mercury, vermilion."[2] These examples give a fair idea of Chinese medication. Practically everything has a use.

The number of drugs in the use of which under similar conditions Chinese and European medicine are at one is not small. To these belong pomegranate-root (for worms), camphor, aconite, cannabis, iron (for anemia), arsenic (for malaria and skin diseases), sulphate of soda and copper (emetic), alum, sal-ammoniac, and musk.[5]

Although many of the things used are useless or harmful, some of the herbs might be worth investigating. Chinese medicine has always laid its emphasis on internal medicine, all other modes of healing being strictly subordinated. The physician did not visit his patient continuously, but only upon repeated invitation. This custom made any real observations upon the processes of disease and actions of drugs impossible.

---

1 Four Milleniums of Chinese Medicine (K. C. Wong) Lancet 2 : 156, July 20, '29; 206, July 27, '29; 260, Aug. 3, '29.

2 Three Crosses in the Purple Mists (W. R. Morse).

3 Old and New Medicine in China (E. H. Hume) Ann. M. Hist. 2 : 272-280, May, '30.

4 Medical History from the Earliest Times (Withington).

5 History of Medicine, Vol. I. (M. Neuburger).

BECKMAN'S "TREATMENT"

The successful therapeutic methods of many physicians and of many years of practice are summarized in this truly great book. Dr. Beckman gives you complete detailed treatment—every kind of treatment. It is a book on practice—telling you what is best to do and when and how to do it.

The London Lancet says:—"This book or its equivalent should be in the hands of every physician—and we have not yet come across its equivalent."

Treatment in General Practice. By Harry Beckman, M.D., Professor of Pharmacology, Marquette University. 2nd Edition, 1934. 889 pages. Cloth, $11.50.

McAinsh & Co., Limited

388 YONGE STREET, TORONTO

You are invited to visit our library where many books on different subjects are on the shelves and may be examined. You will be under no obligation to purchase.

CANCER OF THE UTERUS

JESSIE GRAY, B.A., M.D.,
Toronto General Hospital.

Carcinoma of the uterus in itself is a tremendous disease comprising 40% of all cancer in women, and provides quite sufficient material for a single paper. It is divided into that of the cervix and that of the fundus. These two types are so absolutely different in incidence and structure as well as in mode of treatment that it seems almost an ambiguity ever to speak of cancer of the uterus without qualifying the term as to situation.

Etiology.

About 10% of uterine carcinoma occurs in the body of that organ. This type usually makes its appearance after the menopause and is relatively limited in age distribution, 80% occurring between 50 and 65 years. Hence its mean incidence is fully eight years later than that of cervical cancer which reaches its maximum at 45 and has quite a wide age distribution.

To go on drawing the distinction, cancer of the cervix is practically unknown in women who have had no children and tends to be especially partial to those who have had several, while cancer of the body is somewhat more common in nulliparae.

In one way, however, these two forms of malignancy appear to correspond other than in mere anatomical relationship, and that is that chronic irritation seems to play a leading role in the etiology of both. The injuries of childbearing with superimposed infection are the outstanding factors in cancer of the cervix. Findley claims definite histological evidence that infected lacerations and erosions of the cervix are truly precancerous. He also points out that cancer of the body is almost invariably accompanied by fibroid tumors, polyps and hyperplasia of the endometrium. Here then we have the conditions whose removal would be a definite step toward the prevention of uterine cancer.

Pathology.

Cancer of the **body** of the uterus is almost invariably adenocarcinoma though rarely squamous cell tumors originate by metaplasia or foetal cell rests. It arises from the endometrial lining and is usually cauliflower in type, although sometimes it takes the form of bunches of papillary outgrowths. It spreads slowly and by direct extension through the wall of the uterus into the surrounding tissues and is rarely known to invade the cervix. The body of the uterus retains its normal shape, increasing in size as it becomes filled by the fungating growth, and the slowness of spread is one of the chief factors in the better prognosis of cancer of the fundus over that of the cervix. Its protected position prevents infection and hence also the early cachexia characterizing cancer of the cervix. There appears to be a definite increase in malignancy of cancer of the corpus with decrease of cell differentiation.

Cancer of the **cervix** is divisible in the gross into three types: (1) Ulcerative; (2) Cauliflower, and (3) Indurating. The indurated type is quite rare and is seen chiefly in elderly patients. No definite relationship has been established between these three gross types of growth and its microscopic structure.

Histologically cervical cancer may be epidermoid or adenocarcinoma. Obviously the epidermoid type is thought to arise from the epithelium of the portio vaginalis, and the adenocarcinoma from the endometrium of the cervical canal. Recently the possibility of cancer arising from the cervical endometrium becoming epidermoid in type has entered the question. At any

rate the epidermoid cell type is much the commoner and is subdivided by many pathologists into three grades: (1) Basal cell, (2) Transitional and (3) Squamous according to its degree of differentiation. The degree of malignancy has been found to parallel the degree of lack of differentiation as in tumors of the corpus, but though there is a positive relationship between the apparent malignancy of the growth on histological section and the rapidity of invasion, this does not hold with regard to making an actual prognosis. Because, as was pointed out by Ward, the slower the tumor grows and the less malignant it is that way, the greater is its radioresistance; and conversely, the more rapidly growing and malignant in type, the more the growth tends to yield quickly to radiation. Hence a satisfactory prognosis cannot be made on the cell structure of cervical cancers.

Spread takes place by direct extension and by lymphatic permeation. It rarely invades the body of the uterus but spreads down the walls of the vagina, forward toward the bladder, back along the uterosacral folds and laterally into the paracervical tissues. The iliac, hypogastric and sacral glands are usually the sites of early metastases.

The question of **metastases** is one of great importance from the point of view of prognosis. Generally speaking, the more extensive the primary growth, the longer it has existed, and hence the greater chance of metastases having formed. But unfortunately a minute primary focus does not preclude the existence of metastases. Warren claims that the degree of histological malignancy is a much more reliable index to the likelihood of secondaries than mere size of the primary growth, highly malignant epidermoid cancers averaging over three different sites of metastasis apiece, while those of low malignancy average less than one apiece according to his figures. In order of frequency Warren lists the common sites of secondaries as regional nodes, distant nodes, liver, lungs and bone.

Symptoms and Diagnosis.

Cervix.—The classical symptoms of cancer of the cervix are haemorrhage, discharge and pain appearing in that order.

Bleeding is at first intermittent, usually slight and provoked by douching, straining or vaginal examination. It becomes profuse as the disease advances.

Discharge is also scanty as a rule, pinkish or brown from blood, and not purulent until breaking down of the cancer occurs, but may be from the start if superimposed on an old chronic cervicitis. In the late stages this discharge becomes very offensive and may cause pruritis vulvae.

Pain is definitely a late symptom and indicates that the growth has extended beyond the cervix in the majority of cases, the only exception being where the mass of the growth itself is so great as to cause pressure. Pain on micturition is the commonest type and is very suggestive of involvement of the bladder wall.

Regarding the *early appearance* of cancer of the cervix, Bonney states plainly that he regards the early finding of an endocervical cancer as a piece of luck. Ectocervical carcinoma on the contrary can be seen and hence will often be found early. It occurs always in that region, the size of a quarter, immediately surrounding the external os to which cervical erosions are confined, and rarely develops save in the presence of such an erosion. It may be a soft reddish warty looking elevation closely simulating on erosion in its villous phase, or it may be a distinct ulcer, or it may be a hard sclerotic elevation. In all cases except the last it bleeds easily on manipulation and is friable.

Diagnosis of the advanced disease is, of course, obvious, but *biopsy* is the only certain method of diagnosis in the early stage, and removal of a piece of tissue for section is of supreme import-

ance. One difficulty is in choosing the correct site for the taking of such a biopsy specimen. Recently Schiller has reported a test for the detection of early squamous carcinoma and last February Graves published an account of his results using it, recommending this procedure to the profession as a means of locating areas at which biopsies should be taken. It is a method of distinguishing normal from diseased cervix based on the fact that normal squamous epithelial cells contain glycogen and stain uniformly a deep mahogany colour on painting with compound tincture of iodine. Diseased areas of the cervix and the normal glandular endothelium of the cervical canal do not stain with Lugol's solution and hence stand out as pinkish areas. If the whole cervix is stained uniformly deep brown, you can be sure there is no superficial cancer. But defects in the brown colouration may be due to erosion, leukoplakia, luetic or tuberculous ulceration, eversion of the glandular cervical canal epithelium or loss of surface epithelium from trauma as well as to cancer. Hence the test is of more value in locating sites where tissue should be removed than in actually diagnosing carcinoma.

Once having made the diagnosis of cancer, the *determination of the extent of the growth* is of great importance in deciding the method of treatment to be adopted. This is often a difficult problem and it may be said that in most cases the extent is greater than appears at first sight. Detection of a mass in the lateral fornix is usually held to indicate invasion of the broad ligament but may mean nothing more than an old chronic inflammation. The extent of the involvement of the regional lymphatics cannot be determined except in so far as pressure symptoms may suggest invasion in certain areas. The amount of the vagina involved is of importance in estimating the likelihood of invasion of the bladder, on which operability depends to a large extent. Examination of the urine is of great value here as, if it is clear, invasion of the bladder is known to be very superficial if present at all.

Fundus. The symptoms in cancer of the fundus are also bleeding, discharge and pain. *Haemorrhage* is often the earliest complaint and may start as a menorrhagia but quickly becomes intermenstrual. It is not 'contact' bleeding and as it frequently begins at the time of the menopause when the patient thinks nothing of a little irregularity, it often develops for some time unsuspected. The *discharge* sometimes precedes the bleeding, and does so much more frequently here than in cancer of the cervix. It tends to be of a watery copious nature. *Pain* develops earlier in cancer of the fundus than in that of the cervix, but *cachexia* later, due to the protected state of the growth in this situation, infection and its toxic effects and fetid discharge being greatly postponed. *Glandular metastases* occur late, the commonest method of termination being invasion of the pertioneum with secondaries in omentum and ovary and ascitic distension. In any case of bleeding from the fundus after the menopause, it should be assumed that it is cancer until proved otherwise. Before the menopause and after the mainstay of diagnosis is dilatation and curettage with microscopic section of the material obtained.

Classification of Cancer of the Cervix.

A great deal of thought has been given to the classification of cancer of the cervix because the results of the various methods of treatment depend on the types and stages of the lesions treated, and many methods of groupings have been devised based on different criteria. Hence we find that there are classifications based on the gross appearance of the malignancy and subdivided into early, middle and late stages; there are classifications based on microscopic structure which is of quite some importance in deciding the best method of treatment; but the most important classification is that depending on the extent of the disease, because this in most cases is the determining

factor in the selection of the type of therapy to be undertaken.

The most popular classification in this country is that proposed by Schmitz and adopted by the League of Nations Cancer Commission and the American College of Surgeons. It is a clinical classification of cases into four groups:

Group I. Carcinoma limited to the cervix with free mobility of the uterus and no invasion of the surrounding tissues. Early stage and operable.

Group II. Vaginal fornices invaded with the possibility of slight parametrial and paracervical invasion. Uterus still mobile. Borderline.

Group III. Definite extensive parametrial and paracervical involvement and fixation of the uturus. Inoperable.

Group IV. Stage of so-called 'frozen pelvis' where the cancer forms a mass filling the pelvis having invaded surrounding viscera with or without the production of fistulae and distant metastases.

Treatment of Carcinoma of Corpus Uteri and Surgical Treatment of Cervical Cancer.

The treatment of cancer of the uterus is a bone of much contention. This applies particularly to cervical carcinoma. The controversy centres around the relative values of radium and surgery in the struggle against malignancy.

In discussing the place of surgery and the results obtained by it, it might be as well to deal first with *cancer of the fundus* because almost all are agreed that panhysterectomy is the treatment of choice of carcinoma in this situation. Generally speaking cures range from 60 to 85% following radical hysterecomy and Polak recommends the following scheme of treatment of a case of suspected cancer of the body of the uterus: (1) Diagnostic curettage, (2) Irradiation of the uterine cavity with 100 mgs. radium for 24 hours, (3) Panhysterectomy six weeks later and (4) Post-operative deep X-ray therapy.

Ward states that although hysterectomy is the treatment of choice because of its good results, only 50% of such patients are operable, the rest being placed beyond the range of surgery by the presence of diabetes, cardio-vascular disease, obesity, senility or renal insufficiency. They found that 67% of their cases undergoing operation were alive and well five years later while only 44% of three year survivals were obtained of those for whom irradiation was the only alternative. Lane-Claypon claims 80% operability and 60% five year survival rate. Stockholm reports 43% and Healy and Cutler 58% cures, both using radium in small series of cases. But Findley points out that surgery is the exclusive treatment of cancer of the body of the uterus, not only because it effects 75% cures, but also because the growth is so often situated up in one horn where contact is difficult and the application of radium may merely succeed in masking symptoms until the growth has spread beyond the reach of surgery.

Turning now to the use of surgery in treatment of cancer of the cervix, the two chief surgical procedures are the Wertheim and Schauta operations. Wertheim's operation is an abdominal one in which the ureters are exposed throughout their course and all the parametrial cellular tissue removed as well as the glands of the obturator fossa and along the iliac vessels, the uterus, tubes, ovaries, cervix and as much of the upper part of the vagina as possible. It is a very extensive operation and carries a high operative mortality. The Schauta procedure is also very radical, consisting in the removal of the uterus, adnexa and surrounding cellular tissue in one large mass through the pelvic floor by means of a deep and extensive incision through the pelvic floor into the ischio-rectal fossa.

Bonney considers a patient worth operating if there are no urinary symptoms or signs of involvement of the rectum or of both ureters, and so long as the malignant mass is not adherent to the pelvic side walls or great vessels.

He puts his operability rate at 63% which is much higher than that of any other surgeon to-day. Traumatic shock and sepsis are his two chief causes of operative death, and by utilizing his experience he has reduced his mortality from 20% on his first 100 operations to 8% on his last. Indeed it is likely that his present mortality is actually as low as 6%.

Bonney's results are tabulated on these sheets and may be summed up by saying that the presence of glandular involvement about halves the chance of cure, and that with an operability range of 63% and 42% survivals of those operated, his five year cures amount to 26% of all cases seen. These dwindle to 20% if followed on for the ten year period.

Radium Treatment of Carcinoma of Cervix Uteri.

Results. One of the most outstanding workers in the use of radium in treatment of cancer of the cervix has been George Gray Ward of the Women's Hospital in New York. His results for the term of 1919 to 1927 showed that the primary mortality was 1.1% and five year survivals were obtained in 23.8% of the total number of cases seen despite the fact that only 21.6% of these were operable surgically. The prognosis in cases of adenocarcinoma he found to be better than that of the average growth, 36.4% of these being saved.

Heyman's results at the Radiumhemmet in Stockholm are almost as good as can be found, though his 20% of five year cures dwindled to 16% when followed for the ten year period. In those whose lives could not be saved, the palliative effects were marked. 90% stopped bleeding; 50% had cessation of discharge and 50% were freed from pain; 60% were enabled to return to their occupations for variable periods of time.

Regaud's results for cases treated between 1922 and 1925 at the Radium Institute in Paris are shown in the tables, as are also Healy's, whose report covers 227 cases in all, 18.5% of whom were cured. Lynch at the University of California Hospital used combined radium and surgical treatment to produce the results also shown. Considered collectively, this table brings home the great necessity of getting these cases early.

Technique. Regarding the technique of radium application there are, in the main, just two chief methods: large amounts for a short time, and small amounts over prolonged periods. The latter method is favoured in Toronto

Cervical Carcinoma.

BONNEY 339 WERTHEIM OPERATIONS 1907-1927 RESULTS.

	All Cases	Of all Treated	Gland Invaded Group	No Gland Invasion
Primary Mortality.....		15%	21.6%	10.7%
Five Year Cures	26%	41.3%	24.6%	53.5%
Ten Year Cures	20%			

RADIUM RESULTS.

	Primary Mortality	Five Year Cures	Surg. Operable	Inop. Cases Saved
G. G. Ward	1.1%	23.8%	21.6%	18.2%
Heyman	2%	20%	26.7%	15.7%

RESULTS IN TERMS OF FIVE YEAR CURES IN VARIOUS STAGES.

Stages	Regaud (Radium)	Healy (Radium)	Lynch (Radium & Surg.)
I	73%	52%	58.8%
II	38%	47%	
III	27%	11%	8.2%
IV	Palliation		

except in cases where there are large fungating masses and the cervical canal is hard to find, in which case 80 to 100 mgs. have been used for 24 to 36 hours. Usually eight to ten thousand mgm. hours are given over a longer period, two thirds of this being applied inside the vagina. This is followed by deep X-ray therapy. Heavily screened needles are used for recurrences or deep X-ray therapy if the masses are deep in the pelvis.

Ward stresses the value of careful pre-radiation preparation of patients, particularly cachectic ones, by transfusion. They also believe that post-radiative potassium permanganate douching to reduce sepsis has appreciably increased their percentage of five year survivals. Regarding dosage, they outline a method of giving an initial application of two to four thousand mgm. hours, the subsequent treatments depending entirely upon the reaction to this first dose, that is upon the extent of scarring and healing six to eight weeks following it. They have found this necessary because no two tumors react identically to radium no matter how similar they may appear in extent, gross appearance and structure.

The outstanding principle of their treatment, however, is implicit faith in the great value of re-radiation, and Ward stresses time and again the importance of monthly follow-up examinations to be carried out by the surgeon himself who first applied radium. Using this system of watchful waiting to save the patient from the silent recurrence of growth, he found that 50% of his cases had recurrences and that 26.5% of them were salvaged by re-radiating as often as was necessary.

In marked contrast to this, Healy at the Memorial Hosptial, New York, since 1918 has had only 11.4% of cases requiring re-radiation for recurrences, and of these only two survived more than three years. He suggests that inadequate primary treatment might account for such frequent recurrences as Ward reports.

In spite of its low primary mortality the safe use of radium is not a simple matter, but one requiring great technical skill and knowledge. Because although correct dosage and filtration kills cancer cells and not normal tissues, still insufficient dosage does not kill the cancer cells and excess dosage with insufficient filtration destroys normal tissues as well as the malignant growth and results in haemorrhages, extensive necrosis, septic absorption, fistulae and even death. Hence radium has aptly been called a "two-edged weapon." The two chief contra-indications to radium application are active sepsis, and the condition of frozen pelvis. The exact location and extent of the cancer should be carefully studied, and the general physical condition of the patient assessed and improved as much as possible before treatment is begun. The dosage and method of application of the radium itself are, of course, of great importance, and should be carefully regulated to suit the individual case. The dangers of radium should never be forgotten in enthusiasm to eradicate all the cancer tissue, and the indiscriminate use of radium and correspondence courses in radiation therapy are greatly to be deplored.

Conclusion. Bonney sums up his stand in the radium-operation controversy as follows Surgery at its best treats 60% of cervical cancers and offers 25% five year survivals of all cases—that is, 42% of those operated. Radium at its best offers treatment to 90 to 95% of all cases and five year survivals for 25% of them. Although at first glance it appears as if the results of radium and operation are identical, both obtaining 25% of five year cures, yet on second thought it seems better to apply surgery to the operable cases and reserve radiation for inoperable ones. Because, reasons Bonney, if surgery or radium alone is used on 100 cases presenting themselves for treatment, only 25 are saved in either case, whereas if the operable 60 submit to surgery, 25 are saved, and of the remaining 40 inoperable cases, 5 can be

salvaged by radiation, increasing the five year survival rate to 30%. This is a most convincing argument in favour of the use of surgery on operable cases, operation leaving a wide margin in which to apply radium, while the use of radium precludes surgical treatment entirely.

Bonney also points out that though operative mortality is higher than that of the application of radium, still the end results are the same and most of us, if given the choice, would rather die of operation than of cancer itself. Also patients always know the significance of radium treatment whereas they need not know that of operation, and in view of the terror that cancer strikes in the hearts of many women, this may well be deemed of sufficient importance to constitute an argument.

Ward, as leader of the opposition so to speak, condenses the radium platform into the following factors: The debate is confined purely to the operable cases, because for the inoperable ones the only hope is radium which gives them 12 to 18% five year cures and an inestimable amount of palliation; surgery has nothing to offer short of the radical operation of Wertheim or Schauta, the ordinary panhysterectomy having no more place in the treatment of cancer of the cervix than simple mastectomy has in the treatment of cancer of the breast; such an operation has a primary mortality of 8 to 17% even in the hands of the most experienced, whereas the mortality of radiation is under 2%; Ward considers the best results of surgery and irradiation applied to operable cases as almost identical despite the fact that Bonney claims 42% cures on operable cases and radium only 25%, but Ward is undoubtedly right in his observation that the average of radiation therapy approximates the best much more closely than the average of operative treatment approximates Bonney.

There is no argument to speak of about the treatment of cancer of the body, panhysterectomy achieving 60 to 85% cures. In general the prognosis of cancer of the cervix may be stated to be a 25% chance of five year cures to all cases and a 50% hope for those cases where the growth appears to be confined to the cervix. Dr. Scott adheres to a slightly more pessimistic figure and says that taking all cases by and at large only 20% are cured, but much palliation is obtained for the other 80%.

This superficial glance over the subject of cancer of the uterus, and hasty review of the statistics of five year survivals, serve to show that our methods of treatment are far from satisfactory. Though radiation or operation may cure the patient, they are not, in any sense of the word, cures for cancer. They are make-shifts at best. The limitations of surgery are already apparent, and those of radium are at least in sight. Possibly some day a method of irradiating the whole human body so as to eradicate all malignant foci will be worked out, but at present the notion is utopian. With all due respect to scientific research into the cause of cancer, and admitting that the real cure for this terrible disease will eventually come from this source, still it must be realized that until this cure is discovered the control of cancer of the uterus rests, not in the hands of the pure scientist, but in those of the general practitioner. It is he who controls the two factors which, at present, are the chief determinants of the mortality rates from this source, namely: prevention and early diagnosis. On him rests the responsibility of eradicating those conditions known to be secondary stimulants to malignant growth — irritating factors such as chronic cervicitis with hyperplastic erosions and cystic degeneration. And on him also is incumbent the responsibility for early diagnosis. As Dr. Scott has said, progress of cancer into the advanced stage before treatment, is due equally to the insidious nature of the disease, procrastination on the part of the patient and negligence of the first doctor to see her. Education of the laity on the value of periodic examinations and the signific-

ance of early symptoms will do much to reduce the second, and a realization by the profession of the terrible necessity for a proper pelvic examination and removal and microscopic section of material in cases with suspicious histories will eradicate the last factor.

Cancer of the cervix should not be such a dreadfully fatal lesion. Because to begin with we know much of the initial conditions later developing into secondary causes, namely trauma with superimposed infection; and more important still, the cervix is in a situation easy to examine and lending itself admirably to treatment. Hence cervical cancer is easy to prevent and relatively simply cured in the majority of cases seen in the early stage. It is up to the Medical profession to see that is it prevented, or at least recognized sufficiently early to assure the patient of an excellent chance for her life.

REFERENCES:

1. Victor Bonney. Brit. Med. J. 914. 2. 1932.
2. G. Ward Gray. Surg. Gyn. and Obs. 546. 56. 1933.
3. W. A. Scott. Can. Med. Assoc. J. 290. 29, 1933.
4. W. P. Healy. Can. Med. Assoc. J. 621. 29, 1933.

BOOK REVIEW

RELIGIO MEDICI: Sir Thomas Browne: Everymans. J. M. Dent & Co.

Often have we read of the inspiration that Sir William Osler derived from Sir Thomas Browne's Religio Medici, and yet how many of us have dipped into the pages to search out the philosophy that had such a profound effect upon one of the greatest men that medicine has claimed during the passing centuries. That is the only excuse, but a patent one for bringing this book before the notice of the readers. A few selected abstracts will show the scholarly, yet genial style of this 17th century doctor and philosopher. . . . . "Some will allow no diseases to be new, others think that many old ones are ceased, and that such which are esteemed new, will have but their time. However the mercy of God hath scattered the great heap of diseases and not loaded any one country with all . . . New discoveries of the earth discover new diseases . . . . and if Asia, Africa and America should bring in their list, Pandora's box would swell, and there must be a strange Pathology."

And again. "And though it might be thought that all animals who have lungs do cough; yet in cetaceous fishes, who have large and strong lungs, the same is not observed; nor yet in the oviparous quadrupeds, and in greatest thereof, the crocodile, although we read much of his tears, we find nothing of that notion."

And so the discussion wags, from topic to topic of local medical interest, through the gamut of quaint ideas and medical folk lore, to the deeper problems of man in relation to his fellow beings. It is well worth reading.

THE ETIOLOGY AND PATHOLOGY OF BRONCHIECTASIS

By M. R. CAVERHILL, '35.

Bronchiectasis is the term applied to a condition characterized pathologically by abnormal dilation and inflammatory changes in the walls of one or more subdivisions of the intra-pulmonary bronchial tree.

This condition has been of interest to Clinicians and Pathologists since 1819 when Laennec gave the history, clinical condition and morbid anatomy of four cases. This is the first mention of Bronchiectasis in the literature. From Laennec's first observations, very little has been added to our knowledge of the subject until the last few years, and his account is still remarkably accurate and useful. His theory of etiology is of passing interest. He states that, "it is a temporary dilation produced by a voluminous sputum, and is rendered permanent by the constantly successive secretion of similar ones."

From that time until 1922 there was no appreciable contribution to our knowledge of Bronchiectasis. In that year Secard and Forestier introduced the use of lipiodol injection into the bronchial tree in conjunction with radiography, and so made it possible to verify and give an exact demonstration of bronchial dilation. Lipiodol injection is without danger and permits the study of the morbid anatomy of bronchiectasis in the living subject with far more precision than any other method, and it may be described as the final diagnostic test of bronchiectasis.

During recent years also, the study of bronchiectasis has been approached in a new way by the perfection of the bronchoscope and by the great advances made in thoracic surgery. Our knowledge has been increased tremendously through observations on lungs removed at operation, and the use of the bronchoscope has given us a clearer insight into occasional cases where neoplasims and foreign bodies are the causative agents.

Incidence. Bronchiectasis used to be considered a rather uncommon condition. At the present time, however, whether more cases are being recognized clinically or the condition is becoming more frequent the case incidence is rising. Since the introduction of methods by which the bronchial tree may be visualized the incidence has steadily risen. Jex-Blake in 1920 gave the incidence as 1.9% of all general hospital admissions. In 1930 the disease was considered by Ochsner and others to be the most frequently encountered of all chronic pulmonary diseases, occurring even more frequently than pulmonary tuberculosis.

The majority of writers agree that the condition is somewhat more prevalent in males and that in most cases the process dates from childhood.

To give a better understanding of some of the etiological factors, a brief review of the more relevant points in the anatomy and physiology of the bronchial tree is necessary.

Anatomy. The walls of the bronchi are very similar in structure both in the large tubes at the bifurcation of the trachea, and in the progressively smaller tubes terminating in the lung parenchyma. The lining membrane consists of a ciliated columnar type of epithelium. This overlies a stroma containing numerous mucous glands which open into the surface. Both elastic and muscular elements are present in the walls. The elastic elements have a longitudinal and a circular arrangement which permits dilation as well as lengthening. The most prominent band lies in the mucosa and shows a branching longitudinal arrangement.

The musculature of the bronchi extends the whole length of the tree. In the large tubes the muscle fibres form a complete layer between the cartilage plates and the mucosa. Most of the muscle fibres run in a circular manner but some branch off diagonally to form a continuous network.

When the bronchi enter the lungs the cartilage rings which only partially encircle the tube as in the trachea disappear. They are replaced by irregular cartilage plates which completely surround the bronchus. As a result the intrapulmonary bronchi and their branches are cylindrical and not flattened on one side as the trachea. The cartilages disappear when the diameter of the bronchus reaches one millimetre.

Physiology. It has been shown that during inspiration the bronchi both widen and elongate. Macklin and others have described these movements and they can be seen directly with the bronchoscope or by the injection of lipiodol into the bronchial tree. During expiration the bronchi contract and shorten. On inspiration there is a greater negative or sub-atmospheric pressure in the parenchyma of the lung and the thoracic cage than there is in the lumen of the bronchus. This pressure difference plus the direct pull of the expanding lung on the bronchial wall results in a physiological dilatation on inspiration. Under ordinary conditions of quiet breathing this physiological dilatation is relatively slight and may even be absent in some regions. In vigorous breathing the movements of the bronchi are enormously increased in range. On expiration the dilating forces have temporarily ceased to act and the bronchus returns to its original size through the elasticity of the stretched wall, which in turn, depends upon the integrity of the muscle and elastic elements.

It is not known definitely whether these bronchial movements are brought about simultaneously throughout the whole bronchial system or whether they are brought about by a wave passing from the hilus to the periphery of the lung on inspiration, and oppositely on expiration. Macklin thinks that such a wave of contraction passing from periphery to hilus, would be most efficient in emptying the lung of air.

From these observations we see that the bronchi are not rigid tubes acting merely as passive channels for air conduction. They play a dynamic part in the respiratory function. The importance of this will be seen as the question of etiology is dealt with.

Etiology. The main outlines of the clinical picture of bronchiectasis are well defined but the etiology is varied and there exists a great diversity of opinion among the maze of conflicting theories advanced in the literature.

The next important contribution, after Laennec's initial observations, was made by Andral in 1824 and Stokes in 1837. They thought that the bronchus was the structure primarily involved and that the dilatation was due to a lowered resistance of the bronchial walls, on which was superimposed certain dilating forces within the chest. A year later Corrigan in a paper on cirrhosis of the lungs, presented four cases and stated that the primary condition was a fibrosis of the lungs with resultant bronchial dilatation through contraction of the fibrous tissue. Later Hamilton mentioned pleural adhesions and the rigid chest wall as giving a fixed point of resistance to increase the pulling effect of the diseased lung.

At the present time we may divide the suspected etiological factors into four groups:—

(1) Congenital
(2) Infectious
(3) Mechanical
(4) Miscellaneous.

I. Congenital. Since many cases from the earliest observations on, have been reported in children, numerous attempts have been made to explain bronchiectasis on a congenital basis. In 1880 Grawitz reported a series of cases, chiefly in children, which he thought were all congenital in origin. Sauerbruch who was a strong exponent of the congenital theory believed that most

cases are congenital in origin and draw attention when infection is superimposed. His views are not accepted by many and do not seem to be borne out in the light of present knowledge. Duken and Austrian and others suggest a congenital predisposition as a factor in some cases. Hedblom thinks that the condition might develop in a foetal atelectasis which persists when the thoracic cavity later expands beyond the capacity of the atelectacic lung.

Koeckert has divided congenital bronchiectasis into two types, atelectatic and foetal. The atelectatic type was first described by Heller. Besides development of an atelectatic condition in the diseased lung, there is dilatation of the bronchi through a hypoplasia of the alveolar structure. This results in various sized multilocular cavities with or without open connection with the larger bronchi. Infiltration and pigmentation are absent indicating that the lung has never expanded.

The foetal type is very rare. It is usually unilateral and was the type first described by Grawitz. There may be cystic degeneration of the whole bronchus with all its branches, resulting in one large cavity, or there may be multiple, small, cyptic cavities. The child usually dies "in utero." The cause is unknown although the opinion of a primary maldevelopment of the lung seems to be the choice.

II. Infectious. — Infection of the bronchial wall is generally regarded as the essential etiological factor. Infection destroys the elastic and muscle coats of the bronchi and leaves a weakened bronchial wall. It is the only known cause of such a weakening with the production of bronchiectasis. Ochsner and Hudson suggest that the earliest change caused by infection is simply a loss of tone of the bronchial musculature.

Apparently no specific infection is responsible. It is well known that certain acute respiratory infections may be followed by bronchiectasis. Commonest among these are influenza, whooping cough, pneumonia, lung abscess, and measles. On the other hand bronchiectasis may have an insidious onset without an acute antecedent process.

Adanis and others have laid particular emphasis on an antecedent chronic sinusitis as the primary condition, the infection later localizing in the bronchi. Dr. Warner in a series of cases at the Toronto General Hospital found no history of chronic upper respiratory infection and no evidence of it on examination, in many cases. He concludes that gross chronic upper respiratory infection is not a common cause of bronchial infection leading to bronchiectasis. It seems that sinus infection in the majority of cases plays a concomitant part only in the maintenance of a residual infection.

The majority of observers lay great stress on chronic bronchitis as the primary condition. However, there is some well-founded skepticism regarding bronchitis by itself as a clinical entity as an etiological factor. The fact that the dilatation is usually limited to one part of one lung is against the hypothesis that it is due to a condition usually generalized. Dr. Warner also states that cases proven to be straight uncomplicated chronic bronchitis have seldom developed bronchiectasis later.

Hedblom and Meyer suggest a loss of the antiseptic bactericidal properties of the normal bronchial mucus in bronchiectasis. This permits growth of otherwise inhibited organisms with resultant infection. Retention of secretions providing a favorable medium for infection is also sugested by Meyer.

Bacteriology.—Numerous attempts have been made to incriminate a specific micro-organism in the infective process. The influenza baçillus is present in a certain percentage of cases of bronchiectasis and some authorities have assumed that it was the essential cause of the disease. Boggs in 1905 was one of the first to consider the influenza bacillus as a causative agent. Since then Opie, Blake and Cecil, among others, have attempted to prove its relationship. Influenza undoubtedly accounts for many cases and there has been an

apparent increase in the incidence of Bronchiectasis since the Pandemic of 1918-19.

D. T. Smith from observations on washed sputum states that the essential lesion in primary bronchiectasis is a focal necrosis of the bronchial wall due to the fuso-spirochaetal group of organisms.

The majority of bacteriological reports in cases of bronchiectasis have shown that mixed cultures predominate. Ermatinger working with washed sputum found mixed cultures of pyogenic bacteria in every case. Thorpe studying material obtained through a bronchoscope recovered at least four different organisms in each case.

Greey in an analysis of cases in which lobectomy was done at the Toronto General Hospital, recovered a variety of micro-organisms and concludes that no specific type plays an etiologic role. Fuso-spirochaetal infection was uncommon in this group. In these cases cultures were made directly from the diseased lung following its surgical removal, precautions being taken to prevent contamination. Thus it seems likely that the results of these cultures would give a truer picture of the micro-organisms infecting the bronchi, than coould be obtained from washed sputum or autopsy specimens. Also the bronchiectasis in some of the lungs was as recent as four months, leaving less likelihood of secondary infection.

It appears then that a variety of conditions, with a rather high frequency of recurrent respiratory disease such as influenza and pneumonia, may precede the clinical diagnosis of bronchiectasis. Whatever may have initiated the condition the bacterial complication influences its progress. Many bacteria can infect the areas of lowered resistance and it does not seem necessary to propose any one specific organism to bring about destruction of the normal support of the involved bronchi.

Before leaving the infectious factors brief mention must be made of the so-called acute bronchiectasis or "bronchiolectasis." McNeil states that it occurs quite commonly in children with an acute broncho-pneumonia, affecting small bronchi in the consolidated areas. He believes that it is a pure dilatation with acute overstretching of the bronchial wall unaccompanied by any important structural change and that it is capable of complete recovery without any permanent damage. Thorpe states that it occurs in the terminal bronchioles of marasmic infants. This condition seems rather indefinite and the supposition that it is an entity in itself rather than an early stage in the more chronic process is not well founded.

III. Mechanical. The exact manner in which mechanical factors lead to dilatation after infection has weakened the bronchial wall has given rise to much discussion. With reference to the physiology of the bronchial tree we have seen that the bronchi are not rigid tubes. They dilate and elongate with each inspiration, the dilatation being greater the more vigorous the breathing. On expiration they return to their normal size by means of the elasticity of their stretched walls. If the integrity of the elastic and muscle elements is lost through infection greater dilatation will take place on inspiration, and on expiration they will not return completely to their normal size. This state of affairs progresses, fibrous changes take place in the wall, and a permanent dilatation results. Thus the normal dilating force of respiration is sufficient to permanently dilate a bronchus which has suffered considerable damage.

In health then, the intact bronchial walls are called upon to resist the dilating force of atmospheric or intrabronchial pressure less the sub-atmospheric intrapleural pressure. In any state in which the positive pressure in the bronchus is increased, or in which the so-called negative intra-pleural pressure is increased, the dilating force will be correspondingly augmented. Thus the bronchi will be dilated unless they have sufficient resistance to overcome the

higher tension. Such a state exists in atelectasis, either congenital or acquired, in which case the negative pressure in the thorax is increased. The dilating force of the pressure of the air in the bronchus is thus relatively increased and if the walls have been weakened by infection or developmental fault bronchiectasis will result. This can occur in collapse due to peripheral or bronchiolar obstruction if the larger bronchi are patent centrally.

In connection with atelectasis recent work done by Professor Graham and Dr. Warner is of special interest. They have studied the occurrence of triangular basal shadows in X-rays of chests of patients with bronchiectasis. These shadows occur as triangular homogeneous areas of increased density. Two sides of the triangle parallel the mediastinum and the diaphragm, with the hypotenuse running from near the root of the lung to join the lower side. The mediastinum is shifted to the side showing the shadow and the diaphragm tends to be elevated on that side.

These shadows always contain dilated bronchi as shown by subsequent lipiodol injection. Professor Graham and Dr. Warner believe that these shadows "are caused, in some cases at least, and probably in all cases initially, by a lobar atelectasis of the bronchiectatic lobe, due to a plugging of terminal bronchioles with oedema and exudate." They have produced lobar atelectasis with the typical triangular shadows in dogs by completely occluding the bronchi of the lower lobes

The shadows represent the lower left lobe if on the left side and right lower or lower middle lobes if on the right side. The upper lobes are enlarged and rotated to fill the space in the thorax normally occupied by the lower lobes. They occurred in 6% of all cases studied and are believed to be diagnostic to bronchiectasis. In one case studied a triangular shadow was noted which became much larger and less definite within six weeks, and again became smaller and more dense in another 3 months. This change in size must have been due to an aletectasis which partially cleared and returned, rather than to fibrosis or pull of pleural adhesions. With these cases of lobar atelectasis the bronchiectasis is lobar in distribution. It is due not only to increased pressure difference but also to a greater direct pull on the bronchial walls from the expanding thorax, transmitted through the collapsed lung.

Central obstruction of a larger bronchus from a foreign body, tumor growth, or sputum plugs, within the bronchus; or by pressure of new growth, enlarged glands or aneurysm from without, may lead to bronchiectasis. These obstructions increase the dilating force by acting as a ball-valve, permitting air entry on inspiration but hindering the exit of air on expansion. This results in increased pressure in the lumen over that in the surrounding lung on expiration. This is most marked during the violent expiratory efforts of coughing. Central obstruction also produces a stagnation of secretions in the bronchus distal to the block. This stagnation plus the decreased movement and aeration of the lung provides a very favorable medium for infection. Some think that the actual mechanical pressure of the retained secretions adds to the dilating force.

Other mechanical factors have been advanced from time to time and many of these have been cited as the primary cause. Findlay and Graham have been recent exponents of the Corrigan-Hamilton theory of lateral pull on the bronchial walls by fibrous changes in the lung aided by pleural adhesions. It has been definitely shown however, that dilatation is quite independent of such contraction. Fibrosis if present merely adds to the already sufficient dilating force.

IV. Miscellaneous.—In this group can be placed a variety of suggested contributory causes which under certain conditions may favor bronchiectasis. Among these may be mentioned: (1) nutritional disturbances through occlusion and endarteritis of the bronchial arteries. (2) Loss of nerve con-

trol of the bronchial musculature. (3) Overwork of the bronchi. (4) Metaplasia of the ciliated columnar epithelium to a squamous type at the proximal end of a bronchus forming a block to the clearing out of secretions. This results in stagnation and favors infection.

Pathology.—There are three main types of bronchial dilations found, the cylindrical, the fusiform, and the sacculated. The fusiform and cylindrical varieties are more common in the large and medium-sized bronchi. In the cylindrical type the bronchi are uniformly dilated and usually placed close together. In the fusiform variety the cylindrical dilatation enlarges and becomes bulbous towards the end of the bronchus. The saccular type are more common in the smaller bronchi. A number of sacculations may be present on one tube and the diameter of the tube between the sacculations may be normal. This is called the beaded type.

Bronchiectasis tends to be limited to one lung or even to one lobe of a lung, to involve the base rather than the apex and to attack the left lung more often than the right.

Dr. Robinson has recently made a very complete pathological investigation on sixteen cases of bronchiectasis where lobectomy was done by Dr. Shenstone and Dr. Janes at the Toronto General Hospital. These cases were very favorable for investigation as they were obtained in a fresh state and at all stages in the development of the disease from three months to thirteen years. Also there were no post-mortem changes, as in autopsy specimens to disturb the picture.

In Dr. Robinson's series the removed lobes were all lower ones and were from both right and left lungs. The dilatations were of the fusiform and cylindrical types varying from 4 mm. to 1.5 cm. in diameter.

In the gross, the mucous membrane is soft, velvety and redundant, and of a peculiar greyish or pinkish-yellow color, and may show a mottling with a few small haemorrhagic areas. It is usually thrown into numerous transverse ridges and the bronchial wall is usually definitely thicker than normal. The secretion within the lumen varies in amount and character. It is most often yellowish and mucoid and most abundant in the finer bronchioles leading off from the dilated proximal portions. In most of Dr. Robinson's cases there was little evidence of changes in the adjacent lung parenchyma, although some fibrosis of the parenchyma is usually seen in the more advanced cases.

Microscopically the outstanding pathological lesion is seen to be a chronic inflammatory process resulting in a series of changes which serve to destroy and weaken the normal bronchial wall.

In the early and more acute stages there is marked hyperplasia of the lining epithelium. The epithelial cells are large swollen, and irregular in size and shape. The mucosa is thickened owing to the tendency of the lining cells to grow in a polypoid manner. In most cases the cilia remain intact. There is a considerable amount of mucous exudate containing many polymorphonuclear leucocytes, which is most marked in the lumen of the smaller branches. There is a marked inflammatory reaction in the mucosal stroma with a lymphocytic and plasma cell infiltration. The capillaries are congested and there is considerable oedema.

As the process progresses the inflammatory reaction invades the supporting structures, degenerative changes are seen in the muscle coat, and there is a splitting and destruction of the elastic fibres. This destruction of the muscle and elastic coats gradually goes on to completion and there may also be erosion and destruction of the cartilage plates. Along with the destructive and degenerative changes there is a growth of young fibroblasts and capillaries, and finally fibrous tissue is formed to replace the normal supporting elements.

The bronchial wall may remain intact on one side while destruction on the other side produces a saccular dilatation of the lumen. There is no regeneration of muscle or cartilage and little

or no new elastic tissue appears to be formed. The new wall is usually thicker than the original one but it is a purely fibrous structure and lacks all the elements which give strength and elasticity to the normal bronchial wall. In most of Dr. Robinson's cases the lining epithelium was still intact and the cilia were still active. Some cases show a metaplasia of the columnar epithelium to a squamous type.

Dr. Robinson has emphasized the involvement of the bronchial arteries. In 65% of cases he found definite intimal thickening and sclerosis of these vessels, which was confined to the arteries of the dilated bronchi. This raises the question as to whether this change in the arteries was subsequent to the bronchial inflammation or whether the arterial change occurred first and acted as an etiological factor. At any rate the resistance of the bronchial tissues to the inflammation would be lowered by the diminished blood supply.

McNeil and his co-workers, and Dr. Erb at the Hospital for Sick Children, believe that many of the bronchiectatic cavities, especially those following an acute respiratory infection in children, are the result of a more destructive process. This process involving suppuration and necrosis of the whole wall and even extending into the alveolar tissue. They state that, in this way, expansions of the bronchi are formed which are not due to dilatation proper, but to a process of excavation, and that it is not necessary in order to explain the existence of the cavities, to postulate the operation of any of the factors usually credited with dilating effects. Later the cavity is thought to become lined with fibrous tissue, and in some cases, with a modified type of epithelium growing in from neighboring parts of the bronchus, not involved in the destructive process. Possibly this process may explain a few cases. However, their observations were made from autopsy specimens, in which terminal and post-mortem changes obscure the picture, and would account for much of the ulceration and necrosis that they observe microscopically. In Dr. Robinson's observations on surgical specimens only a few small areas of erosion were seen.

Summary. In this paper I have endeavored to present the contemporary views that are held in regard to the etiology and pathology of bronchiectasis, and to emphasize those which are more generally accepted and seem most logical. No doubt some of the more important facts have become obscured in the mass of controversial and less relevant material. I will attempt to summarige them briefly:—

(1) Bronchiectasis is a fairly common condition, a small percentage of cases are apparently congenital in origin, but the great majority are acquired.

(2) The bronchus is the structure primarily involved and infection of the bronchial wall, arising either from certain acute respiratory infections, or having a more insidious onset is the chief etiological factor.

(3) No specific micro-organism or group of micro-organisms is responsible.

(4) There is a normal physiological dilatation of the bronchi on respiration which is sufficient to bring about permanent dilatation when infection has destroyed the elastic and supporting structures of the bronchial wall.

(5) Other mechanical factors are merely accessory in that they add to the dilating force or favor continued infection.

(6) The essential pathological lesion is a chronic inflammatory change in the bronchial wall, with varying degrees of degeneration and destruction of all its elements, with replacement by fibrous tissue.

BIBLIOGRAPHY

1. Warner, C.M.A.J., 27, 1932: 583.
2. Shenstone & Janes., C.M.A.J. 27, 1932: 138.
3. Erb., Arch. Path., 15, Mar. 1933.
4. Robinson., Brit. Jour. of Surg. Oct. 1933.